Uninterrupted Power Supply

Project Work

Submitted in partial fulfilment of the requirements
for the award of the Degree of
Bachelor of Engineering
In Electrical and Electronics Engineering
of the Bharathiar University, Coimbatore.

1992-'93

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Certificate

This is to certify that the Project Report entitled

"Uninterrupted Power Supply"

has been submitted by

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A C K O W L E D G E M E N T

We are extremely grateful to our guide Prof.CHRISTIAN PAUL, M.Sc(Engg)., M.I.S.T.E., Assistant Professor of Electrical and Electronics Engineering for his excelent guidance, constructive criticisms and help, without which the project would not have materialsed.

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We are highly indebted to our Principal Major **T.S.RAMAMURTHY** for the facilities provided to accomplish this project.

We feel elated in manifesting our sense of gratitude to the members of staff, in particular Mr.S.KUMAR M.E., and the laboratory technicians for their valuable help at all stages of execution of the project work.

Our special thanks to our FRIENDS for their help in the fabrication of this Project.

SYNOPSIS

With the advent of computers making inroads into all walks of life the UPS is a must in all organization expecially when the utility power is not reliable. In this project an attempt has been made to construct a reliable UPS system. This project explains the design of an inverter to provide UPS from a battery source.

CONTENTS

CHAPTER - I

INTRODUCTION

Indian Industry is waging a hopeless struggle against the country's erratic power supply, with demand for outstripping supply, load shedding and power cuts are on the increase, back up power systems are almost indispensable. If the back up power in form of Diesel generator sets is not available, a UPS may be the only answer.

The report discusses the details of 'uniterupted power supply which comprises of charger transformer and Rectifier to convert AC to DC. This charges the Battery at the time of mains supply. If in case, the supply goes off battery automatically supplies power throuh an inverter section, the output being stepped up using an inverter transformer.

This project also highlights the need, application and advantages of the UPS.

1.1 WHAT IS AN UPS

An uninterupted power supply (UPS) is a standby regulated power supply placed between the user's equipment and power source of smooth and immediate back up power supply in case of utility power of failure, it also gives a certain degree of protection against surges, spikes, transients and other power disturbances. An UPS system is the only device which can offer protection from power corruption problems and maintanance of load blackout and brownout condition.

1.2 NEED FOR UPS SYSTEMS

The continuing growth of data processing requires better and better performing computer system with ever higher rates of availability, especially in the case of real time work. To acheive these objective it is necessary to have a reliable and elaborate data processing equipment and very high quality power supplies. these high speed digital equipments are very sensitive to perturbations on the power lines. Momentary high or low voltage transients, dips and surges also cause equipment damage or shut down depending on the magnitude. Hence it is becoming increasingly important to isolate these systems from the utility power supply by an interface which will suppress transients and provide short time ride through capability. The UPS is by and large the best interface equipment for this purpose.

Certain loads, called critical loads, small power disturbances could damage the equipment or even endanger its life. For such loads it is vital that smooth power is constantly supplied.

Examples of critical loads would include computer systems, military installations, satellite and radar systems, patient monitoring systems in hospitals industrial safety monitoring systems and industrial process control systems.

A computer system in operation will fail completely if the utility supply is out and power is not restored within a few milliseconds. Power disturbance could lead to problems like data corruption, disk head crush or magnetic tape stretching.

In case of patient monitoring systems, power failure could lead to patient complication. At the same time power disturbance could lead to false alarms and doctor being provided with erraneous information.

Even for the other systems mentioned above complication will arise in the event of power failure and it is therefore necessary to protect these systems. For the back up to be effective it is necessary that power is restored within a very small interval of time.

The three basic points that come under consideration are the continuity of energy supply, the quality of the voltage wave that takes place in a network , reliable as it may be, continuity can be ensured only through storage of sufficient energy of quality waveform. This expresses a degree of stability and of harmonic neutralisation implying total independence from the network. Reliability rate refers to the use of reliable elements suited for redundancy and requiring little or no maintainance. UPS , the static interface best satisfies the imperatives described.

1.3 POWER PROBLEMS

The electrical power supplied by the various electricity boards and undertakings in India is not regulated and suffers from major drawbacks. These, if not rectified, will seriously damage sensitive appliances which are directly connected to the AC mains supply.

The power problems can be classified into three broad categories - power failures, voltage fluctuations and noise.

1.3.1 POWER FAILURE (BLACKOUT)

Blackout is the total loss of power and is the worst of the under - voltage conditions. If there is a blackout even for a second, the data on the RAM gets erased, thus, resulting in a loss of data which could be from one page of text to say 50 pages. Not only this, if the power failure takes place while some data is being saved, it could result in a disk crash.

1.3.2 VOLTAGE FLUCTUATIONS:

Ideally, utility power should be supplied at a constant voltage of 220v AC, but practically this is not so. The power supplied has spikes, surges or brownouts.

A spike is a sudden burst of very high voltage lasting for less than five milliseconds. a surge is a similar over-voltage condition but lasts for a few seconds. If the over-voltage is severe enough, it can slip past the SMPS and blow up the chips inside the PC. A sustained high voltage may damage the SMPS itself.

Spikes and surges are generated when any motor or other inductive appliances which are in the vicinity of the PC are suddenly switched off. The magnetic field collapses and all the stored energy slides down the power line as a spike. Smallar motors like that of refrigerators can generate spikes of thousands of volts.

Even if spikes and surges are not of very high voltage, the tend to damage the crystal structure of the

semiconductor, degrading to further spike damage. Spikes and surges are thus one of the major reasons for the ageing of electronic equipment.

Brownouts occur when line voltage drops to a dangerously low level without really switching off. This happens on application of sudden heavy loads.

1.3.3 LINE NOISE

Noise occurs when the input voltage is transposed with other waveforms of high frequency for a short duration. It usually consists of short duration over - and under - voltages. If noise enters a system it could cause data error and memory bits to randomly change their states resulting in parity check errors that are fatal for the program that is running. It could even cause changes in the go unnoticed and may be very difficult to locate. If the noise voltage exceeds a few dozen volts, it could spark across the connectors of the chips and below them up.

1.4 ADVANTAGE OF USING UPS OVER OTHER CONVENTIONAL SYSTEMS:

The advantage of using an UPS over other conventional systems like generator, battery bank, etc are

1. UPS is an online system which supplies power to the load instantaneously when utility power fails whereas in other conventional standby systems, manual switching is required which takes more time. Hence UPS is preferred when critical loads like computers, bio-medical instruments, etc are used.

2. Other conventional standby systems required frequent maintainance in order to render trouble free operation whereas UPS does not require much maintainance.

3. Other conventional standby systems cannot accomadate themselves against load fluctuation while an UPS can give us a constant output voltage irrespective of load fluctuation.

4. In case of a short circuit an UPS can give protection to the load since it is isolated from the load. The conventional system does not give any kind of protection to the load.

CHAPTER - II

TYPES OF UPS

ups systems are of two types - on - line UPS and off-line UPS.

2.1 OFF-LINE UPS

In 1983 the off-line or the stand-by UPS was developed with a view to provide power protection at a reasonable cost. An off-line UPS Fig(1.1) and (1.2) monitors the AC power to the attached equipment. The moment the power goes below or above the set limits, it transfers the load to the inverter which draws the power from the attached batteries. There is a time lag-known as the transfer time - when the off-line UPS switches from the mains power to the inverter. Thus the transfer time of a UPS is the time taken by it to switch from mains to battery supply. an average computer system can sustain itself for 25- to - 30 milli seconds after the power failure. When the mains power supply is resumed the load is automatically transferred back to the regulated mains and the batteries are recharged. The output waveforms of an off-line UPS is normally a since wave equipment to a quasi-square wave or a sinewave.

The technology of a rapid transfer time is fairly recent. Older UPS systems were always on-line because of this limitation. The backup time provided by a UPS is dependent on the battery power.

2.2 ON-LINE UPS

On-line UPS systems are the ultimate in power protection devices available today. In a true on-line system the attached equipment is isolated from the power line, i.e. power always passes through the inverter to the SMPS(Switch Mode Power Supply) of the computer. Fig (1.3 and 1.4)

The on-line UPS consists of a rectifier battery charger, inverter and control circuitry. When the AC is present, the rectifier unit converts the AC power to DC power off the same voltage as that of the attached batteries and supplies it to the inverter. The inverter with the help of the control circutry inverts the DC back to AC. In the event of a power failure, the inverter in the UPS draws its power from the batteries. There is no break, switching or interruption in the power supply. When the power returns, the batteries are automatically recharged.

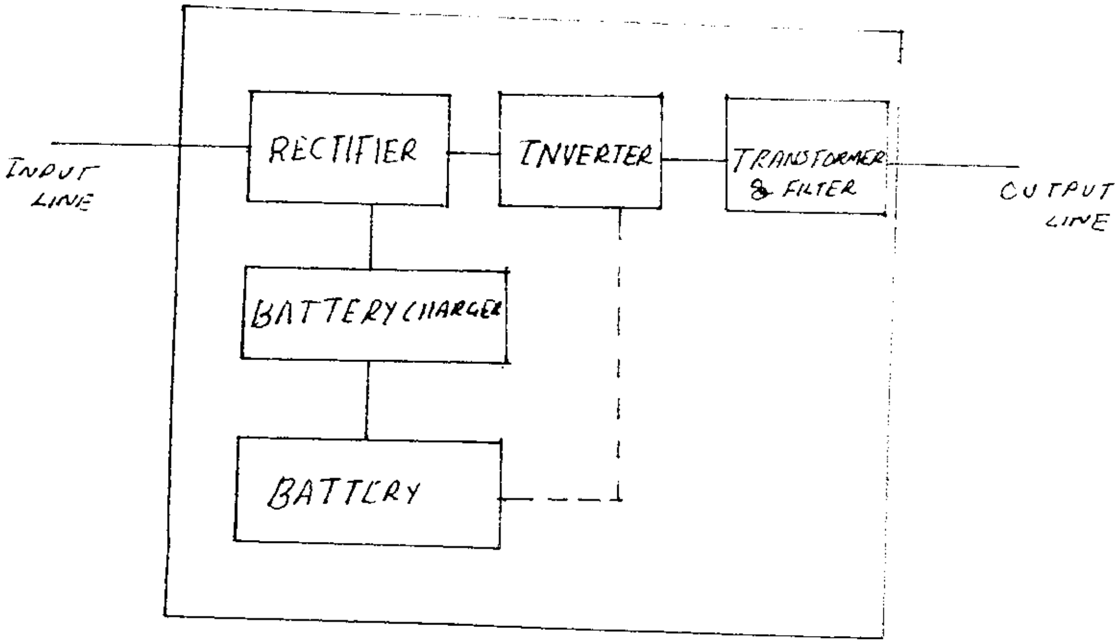

FIG 1·3 - BLOCK DIAGRAM - AN ON LINE UPS (POWER FROM MAINS)
- - - - = INACTIVE PART

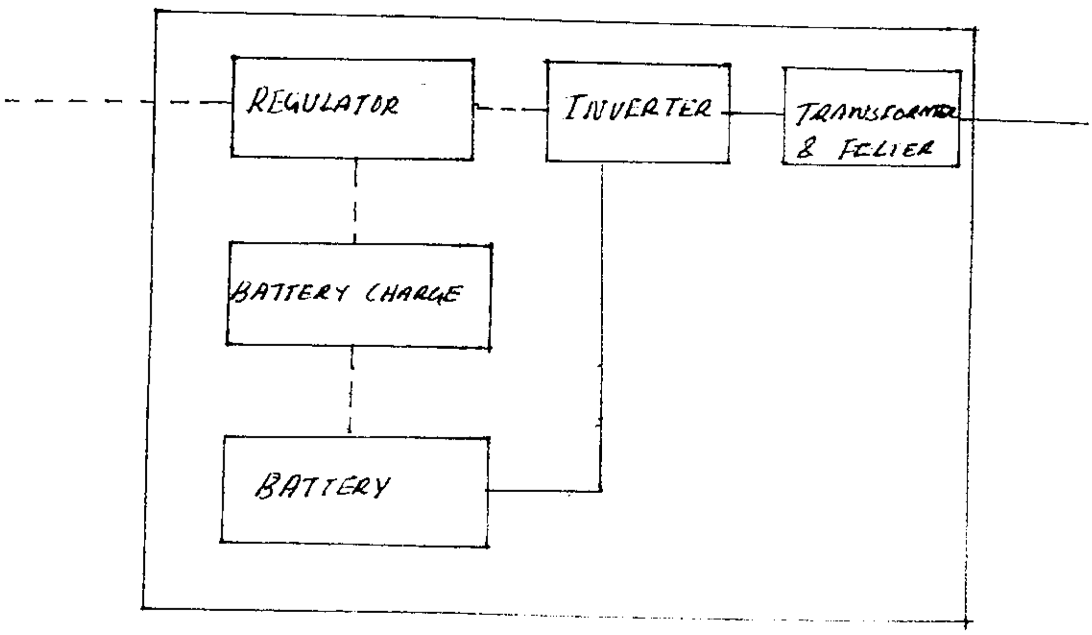

FIG 1.4 - BLOCK DIAGRAM - AN ON LINE UPS (POWER FROM BATTERIES)
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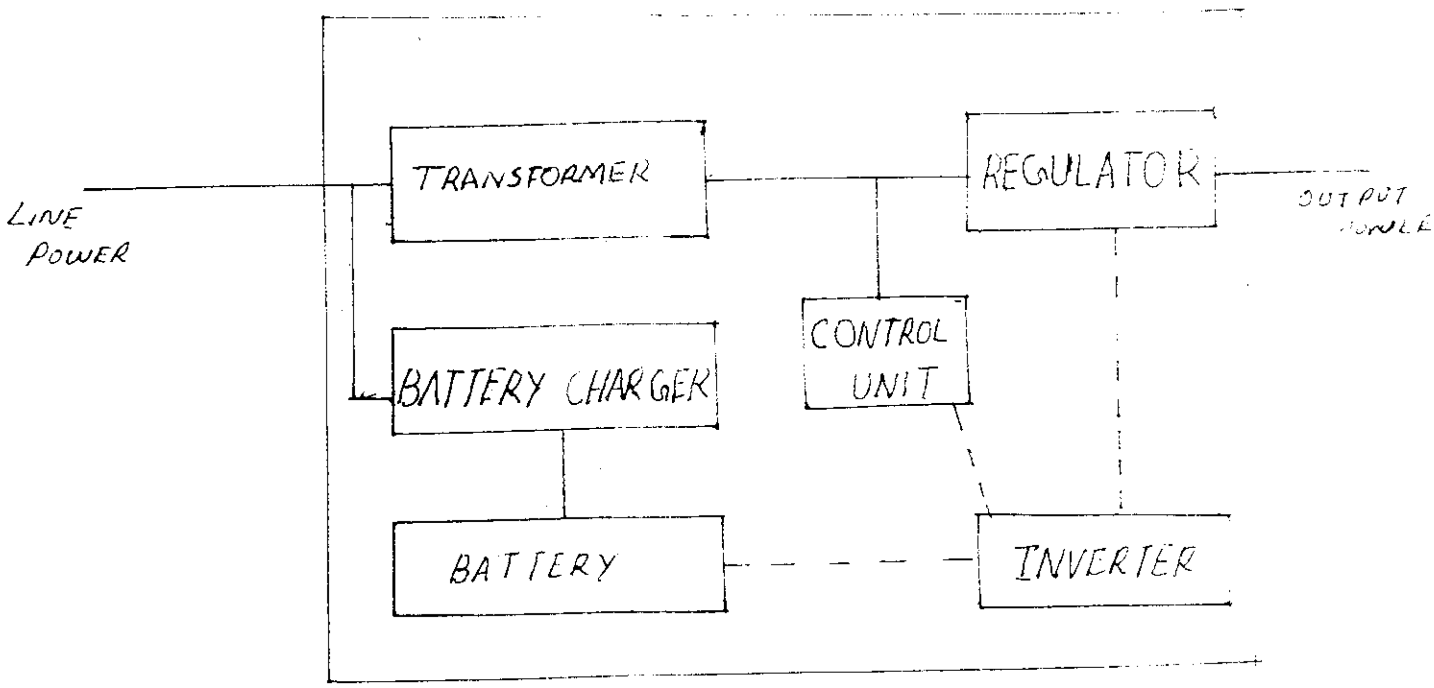


FIG 1.1 - BLOCK DIAGRAM - OFF LINE UPS (POWER SUPPLIED FROM MAINS)
- - - - - = INACTIVE PART

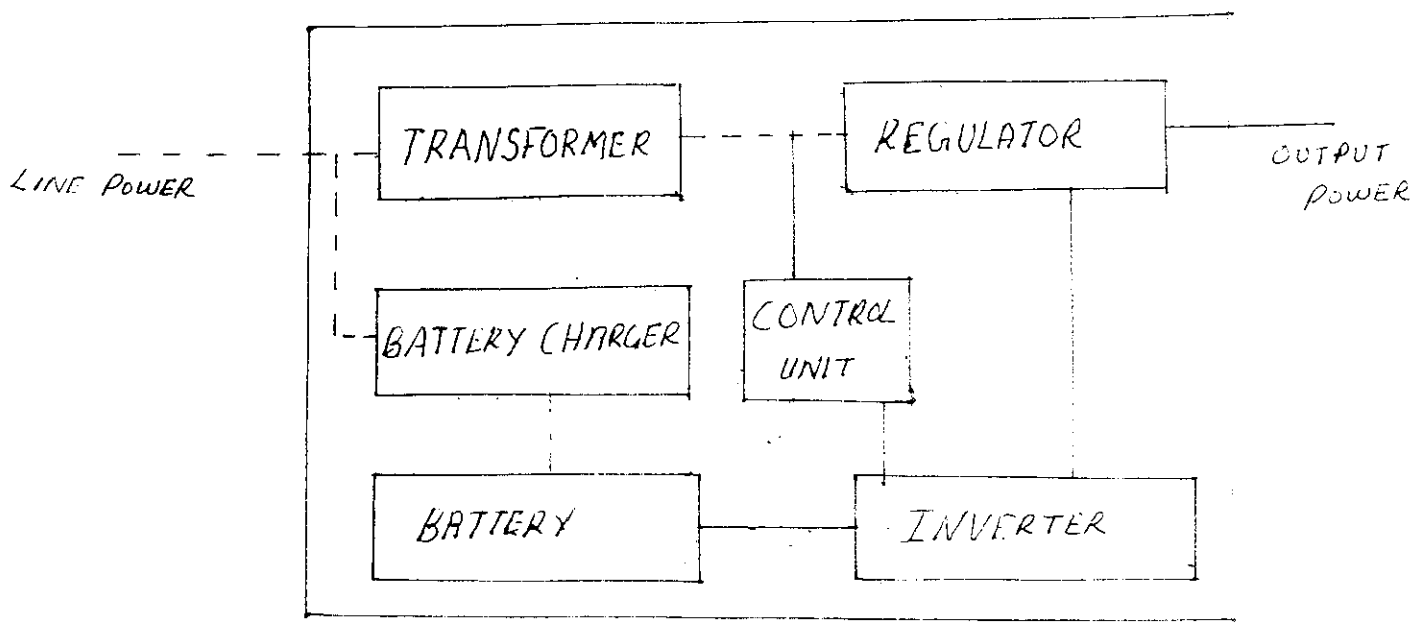


FIG 1.2 - BLOCK DIAGRAM - OFF LINE UPS (POWER FROM BATTERIES)
- - - - = INACTIVE PART

CHAPTER - III

DESIGN OF UPS

3.1 BLOCK DIAGRAM EXPLANATION:

The main circuit of the UPS can be classified into two categories namely,

(i) Battery charger and

(ii) Inverter (DC- AC)

3.1.1 BATTERY CHARGER (Rectifier)

Its main functionis to supply the inverter and charge the battery bank. Safety margin is provided on the charger to take care of any overload condition at the inverter output. After an emergency condition, when the charger starts charging the battery bank (which will be in discharged condition), a heavy current will be drawn by the battery bank. This should be taken care by the current limiting circuit of the charger. BLOCK DIAGRAM shown in fig (3.1)

An EMI filler is generally included at the input of the battery charger rectifier to prevent electromagnetic interference (EMI) from going to the commercial line. EM interference can be generated by the switching thyristors of the battery charger rectifier. Its output is filtered by a low-pass filter.

The rating of the battery charger rectifier depends on the load, the inverter efficiency, the current needed to charge the battery bank etc. It the time required to recharge the battery bank after a mains failure is to be short, then the size of the charger goes up. This also has other protections, such as phase fail protection, thermal overload protection etc.

3.1.2 BATTERY BANK

Several types of batteries are used as lead antimony, nickel cadmium, gel electrolyte, lead acid and lead calcium.

Lead antimony requires complicated charging techniques and high level of maintainance. Nickel cadmium offers a high storage level but at a high cost. It is extremely well suited for conditions. With space limitations or where the temperature is very low. The gel electrolyte battery is used mostly in smaller UPS systems. It is costlier than the liquid electrolyte lead acid battery, but the main advantage is that it is sealed and maintenance - free.

The size of the battery bank is detrmined by factors such as :

1. The load for which it should supply power.
2. The time for which it should provide backup.
3. The input voltage required by the inverter.
4. The efficiency of the inverter.

The battery bank cannot be discharged beyond a certain limit. Otherwise permanent damage will occur. Therefore, there should always be a mechanism to disconnect the battery bank from the inverter once the discharging limit is reached.

3.1.3 TRANSFER SWITCH:

This high-speed device should be capable of switching the load from one source to another within a few millieseconds because most of the equipments can tolerate only this minimum switching delay. It has some very complex sensing circuits to monitor the inverter output and the commercial AC line, so that the load can be properly switched to the correct source of power at all times.

3.1.4 INVERTER

This plays an important role in the UPS because it is responsible for converting DC to AC to feed the load. It should also suppress problems such as harmonic distortion, transients and frequency instability, even when there is some change in the load or in the inverter input. It determines the quality of the power fed to the load.

The inverter generally has protections to take care of sudden surges in output load or the under over - voltage conditions at the input. Some different types of inverters are:

a. Ferroresonant type inverter:

Basically it consists of a square wave inverter and a tuned output transformer that is responsible for currentlimiting and designed very easily. It is low cost and many units can be easily connceted in parallel. The main disadvantage is the large size of the transformer and the low efficiency of about 70 to 75 percent. Normally, this type is not used above 20 - 25 KVA rating.

b. Quasi square wave inverter:

Here two square waves are superimposed on each other to set an approximate AC sinewave. To get voltage regulation, SCR bridge and other control circuits are used to modify the width and the relationship between the two square waves. A filter is used to shape the output waveform. The main disadvantage of this inverter is that it involves complex voltage and current feedback circuits for voltage regulation and current limiting.

c.Phase shifted square wave inverter:

Here N square wave inverter are used. These are sequentially phase shifted by 180 N degrees. Each phase of the system's output is made up of the contributions from each one of the N inverters. This is done by the phasor addition done by the transformer windings.

d. Pulse width modulated inverter:

Here a single inverter switches at a frequency that is many times higher than the fundamental frequency. The pulse width is manipulated to achieve a sinewave shape. It has a very high efficiency and its responses to powerline transients is quick. But due to its complex design it is very costly and hence it is used only in high capacity UPS systems.

3.2. FULL WAVE RECTIFIER TO CHARGE 12V BATTERY

The secondary of the transformer XI should give an output of 12-0-12V AC. This voltage is rectified through FL1 comprising of 1AMPS diodes ie; 6A6 as a full wave rectifier. The charge circuit in Fig (3.2)

The top of the transformer secondary is positive with respect to the centre tap, while the bottom of the transformer secondary is negative with respect to the centre tap. At this instant the diode D2 is forward biased and current will flow through it and since diode D3 is reverse biased no current will flow through it. Thus, during this cycle only the upper half of the transformer is connected to the load by diode D2 which acts as a closed switch. The lower section of the transformer is disconnected from the load because the lower diode D3 acts as an open switch.

When the polarity of the input changes, making the top of the bottom of the transformer, diode D3 conducts, connecting the bottom half of the transformer to the load, while diode D2 does not conduct, thereby disconnecting the upper half of the transformer from the load.

The negative of the rectified voltage is connected to the negative terminal of the battery direcrtly. The positive of the rectified voltage is connected to the positive terminal of the battery through relay RL1 contact. Now when the relay is on (activated) the battery is connected to its respective (battery) terminals, the charging current will flow to the battery.

When the AC mains supply is present, it is available to output socket SK1 and also to battery charge transformer X1. This energises relay RL1 and the battery gets charged. The battery voltage charges to its peak 12.3 volts at an rectifing voltage of 24.5 volts the rectified voltage is 13v.

There will be no more current flow from the charger to the battery. Diode D4 at this stage prevents the flow of current because it is reverse biased.

On mains supply failure, relay RL1 goes to its OFF (deenergised) position quickly, connecting the battery to the inverter circuit and the output of the inverter to the output socket SK1.

3.3 555 IC - TIMER

The 555 timer is a highly versatile low - cost IC specifically designed for precision timing applications. It can also be used in monostable multi - vibrator, astable multivibrator and schmitt - trigger applications. The 555 Timer internal configuration is shown in Fig (3.3)

The 555 has many attractive features. It can operate 4.5 to 16v. Its output can source (supply) or sink (absorb) and load current up to a maximum of 200mA and so can directly drive loads, such as relays, LEDS, low - power lamps and high impedance speakers. When used in the 'timing' mode, the IC can readily produce accurate timing periods variably from a few microseconds to several hundred seconds via a single R-C network. Timing periods are virtually independent of supply rail voltage which have a temperature coefficient of only0.005% per c can be started via a TRIGGER command signal and can be aborted by a RESET command signal.

When used in the astable mode both the frequency and the duty cycle of the waveform can be accurately controlled with two external resistors and one capacitor. The data of IC 555 Timer is shown in Fig (3.4)

3.3.1 555 IC IN ASTABLE MODE

When the circuit is connected as shown, it triggers itself and runs as a multivibrator. Fig (3.5) The external capacitor charges through R1 abd R2 and discharges through R2 only. Thus the duty cycle may be precisely set by the ratio of these two resistors.

In the astable mode of operation C1 charges and discharges between 1 3 VCC and 2 3 VCC. As in the triggered mode, the charge and the discharge times and therefore frequency are independent of the supply voltage.

The charge time (output HIGH) is given by,

$$t1 = 0.693\ (R1 + R2)\ C1$$

and discharge time (output low) by,

$$t2 = 0.693\ (R2)\ C1$$

Thus the total period T is given by,

$$T = t1 + t2 = 0.693\ (R1 + 2R2)\ C1$$

The frequency of oscillation is then

$$1\ T = \frac{1.44}{(R1 + R2)\ C1}$$

The duty cycle is given by $D = \frac{R2}{R1 + R2}$.

3.4 INVERTER AND POWER AMPLICATION CIRCUIT

The inverter covered in this circuit converts the DC 12V of battery voltage into 230v AC supply with a frequency of 50 HZ.

When the inverter circuit gets +12v from the battery, 555 timer IC1, connected in astable mode, starts oscillating to produce square wave. The value of resistors and capcitors are calculated and connected in such a way that the square wave frequency will be 50 HZ.

Diode D5 is reverse biased to guard against any harm due to reverse connection of the battery at the time of testing or installation. Circuit Diagram is shown in Fig (3.6)

The 555 timer (IC1) operates as astable multivibrator generating square pulses of magnitude 0.12v . Transistor Q2 (CL-100) acts as an inverter. So when a zero level of the pulse is applied to the base of Q2, 12v is obtained at the collector of Q2. There will be some drop across resistor R5 and applied to the base of Q3 and thus Q3 will conduct.

The output of Q3 drives the transistors Q5 and Q7 connceted in darlington configuation through resistors R7 and R11. The output transistor Q7 drives power transistors Q11, Q12 and Q13 so, the voltage at point B of inverter transformer X2 is zero.

Now voltage at the centre tap of inverter transformer X2 is also 12v so the current will flow from 0 to B in the primary winding of inverter transformer X2. During this period transistor Q1 and hence Q8, Q9 and Q10 (paralled power transistors) will not conduct.

When 12v of the pulse is applied to Q2, the output of Q2 is zero. So Q3 and transistors Q11, Q12 and Q13 will not conduct. Therefore the voltage at point B is zero.

When 12v is applied to the base of Q1 through R2, Q1 will conduct. The output of Q1 is connected to Q4 through R6. So now Q6 will drive output transistors Q8, Q9 & Q10. The output voltage at point A is zero. So the current will flow from point 0 to A. The resistor R10 and capacitor C5 for a filter to filter the output of Q8, Q9 and Q10, before being applied to the inverter transformer. Similarly C6 and R13.

Thus the primary of the inverter transformer gets stepped up to 230v AC at the secondary of the inverter transformer. Thus we get an output 230v AC, 50 HZ, Single phase supply with the use of this inverter.

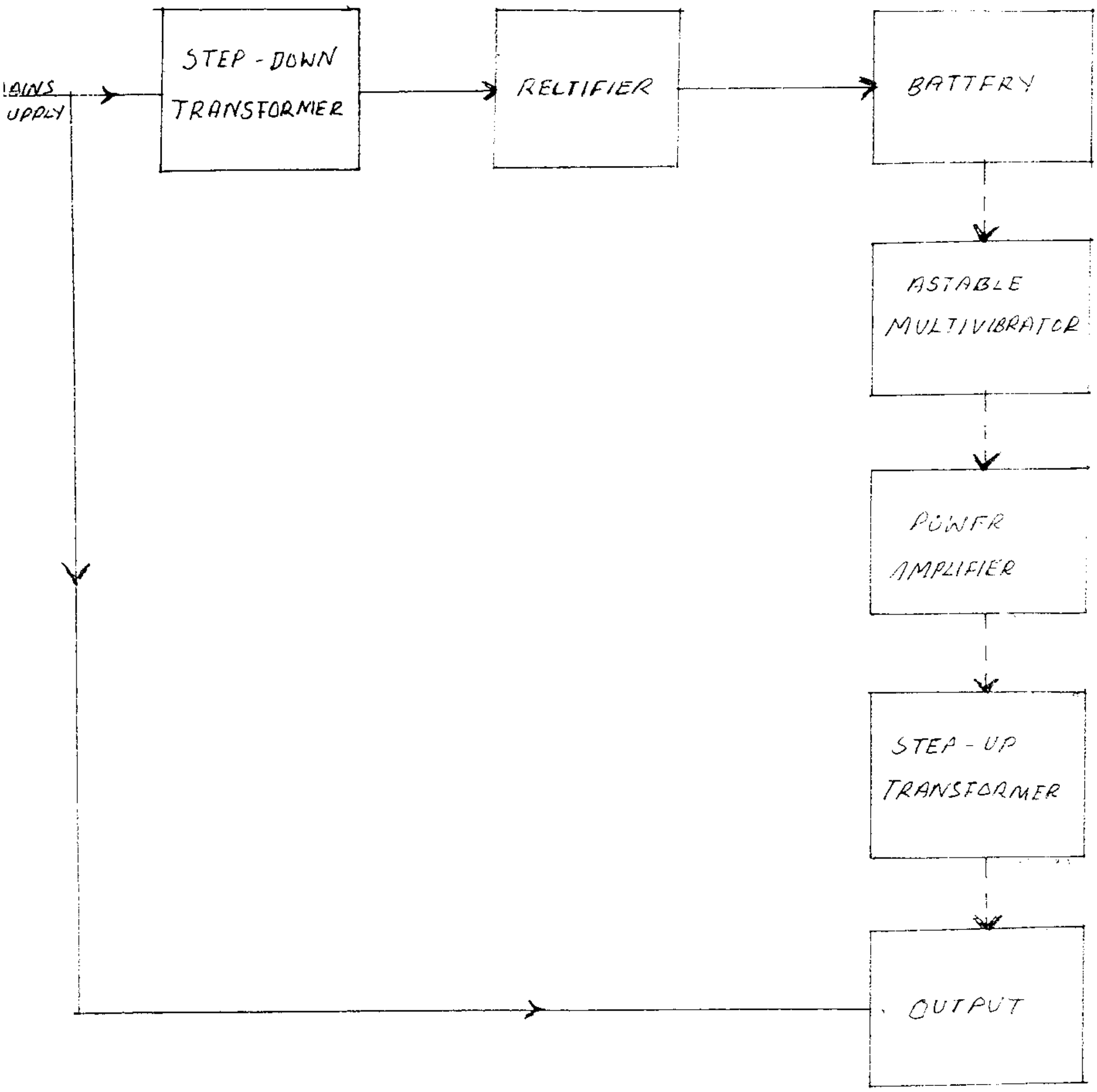
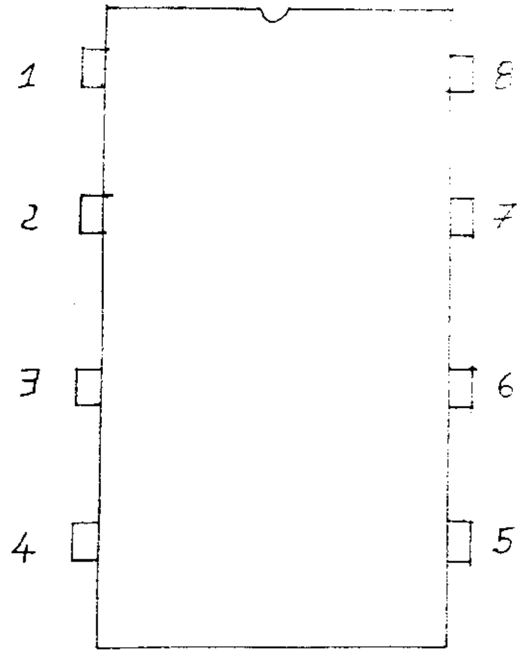


FIG 3.1 - BLOCK DIAGRAM OF UPS SYSTEM



1. GROUND
2. TRIGGER
3. OUTPUT
4. RESET
5. CONTROL
6. THRESHOLD
7. DISCHARGE
8. SUPPLY

MAX RATING

SUPPLY VOLTAGE	+18
POWER DECIPATION	600 MW
OPERATING TEMP-RANGE	0 to +70°C
STORAGE TEMP RANGE	-65 to +150°C
LEAD TEMP	+300°C

FIG 3.3 - DATA OF 555 IC

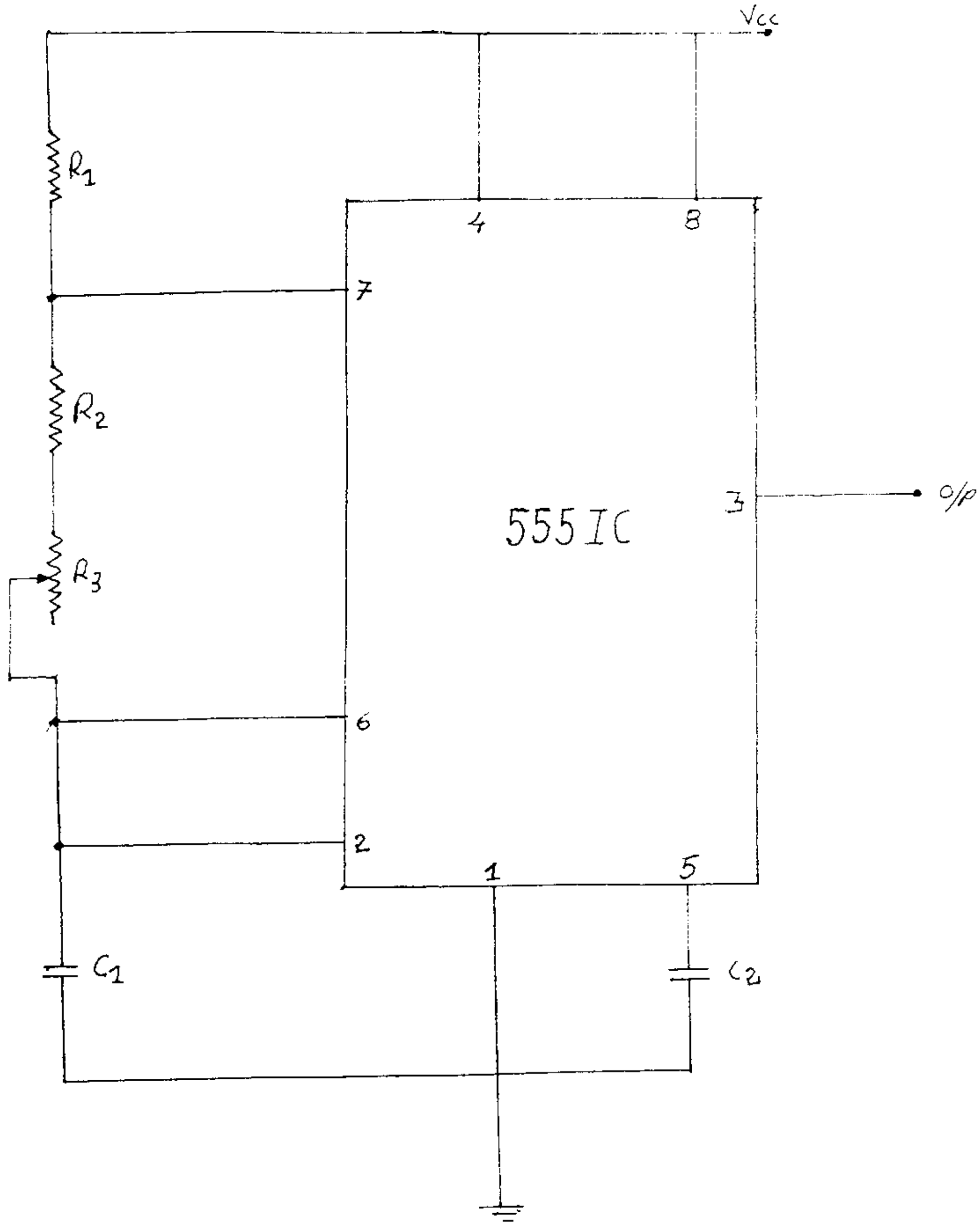


Fig 3.4 · 555 Timer In Astable mode

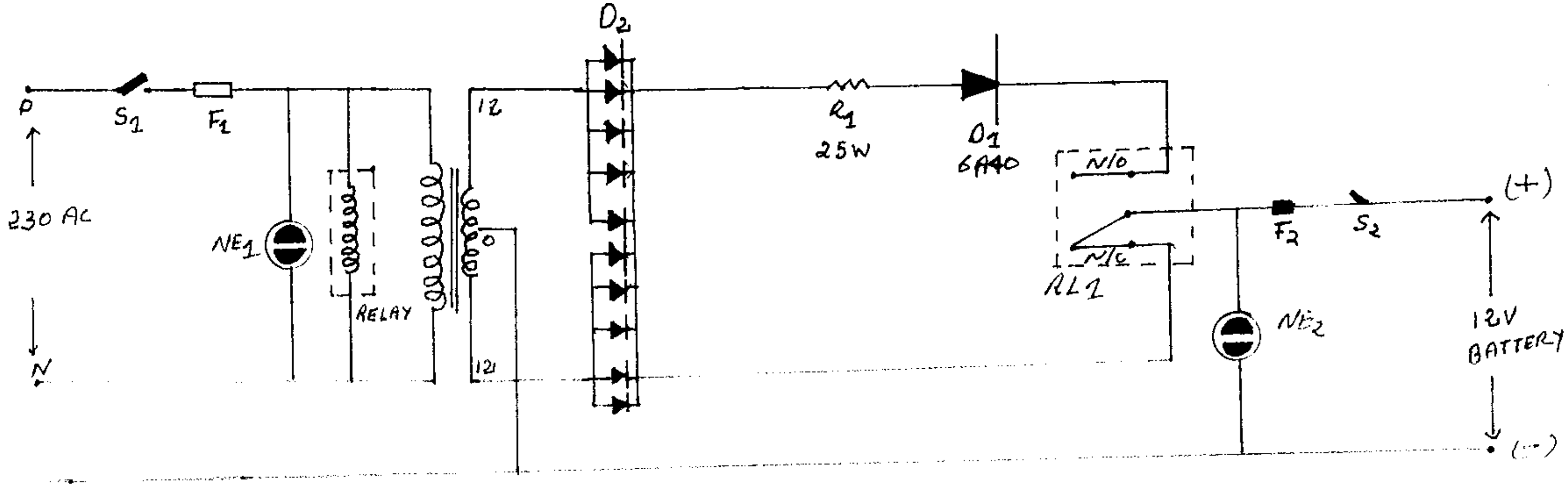
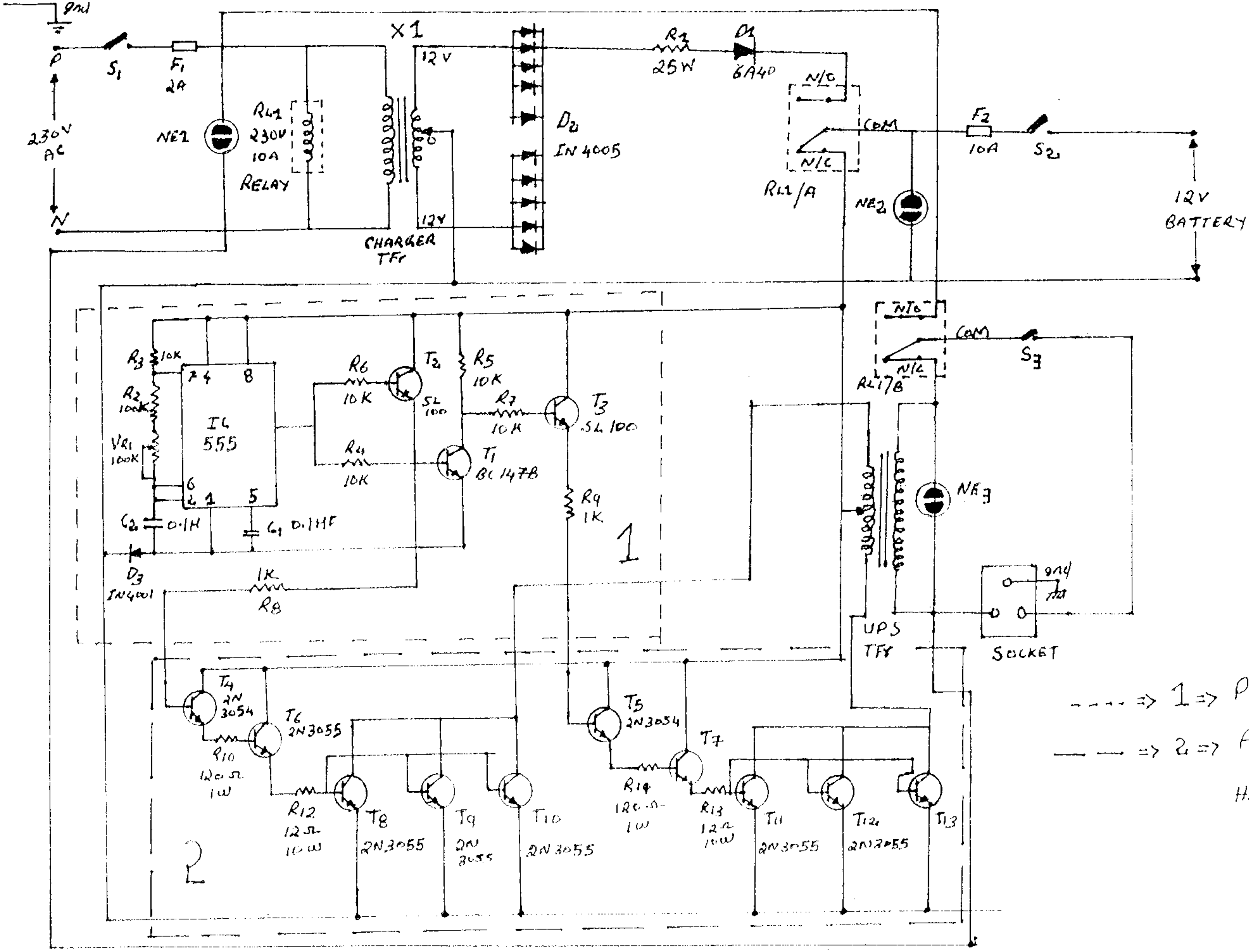


Fig. 3.5 – Charging Circuit



- - - - => 1 => PCB Section

— — => 2 => Amplification Section Heat Sink

CHAPTER - IV

TROUBLE SHOOTING AND SPECIFICATION

4.1.TECHNICAL SPECIFICATIONS:

INPUT

Voltage	-	230V Ac & 12V DC
Inverter Voltage	-	12V DC
Inverter current	-	13A
Power Drawn	-	155W
Inverter Source	-	Battery
Source ripple	-	2%

OUTPUT

Voltage	-	230V AC +/-5%
Current	-	1A
Rated Power	-	150W
Frequency	-	50Hz
Phase	-	Single

4.2 TROUBLE SHOOTING

S.No.	NATURE OF FAULT	POSSIBLE CAUSES	REMEDY
1	No output	1.Output fuse F_2 blown	Check for continuity (or) Replace the fuse F_2
		2.Input fuse F_1 blown.	Check for continuity (or) Replace the fuse F_1.
		3.Battery may be fully discharged	Ensure that the battery voltage is not less than 10 volts. Charge(or) replace.
		4.Fault in square wave generator.	Check and replace the faulty. Check the IC.
		5.Fault in inverter transformer sec. soldering point	Rectify the fault.
2.	Overload	Check the inverter o/p current.	Reduce the load or check the inverter i/p current without load. If it exceeds the rated value check the circuit.
3.	Absence of humming.	1.Fault in fuses 2.Improper connections.	Rectify the fault.

4.3.ADVANTAGES

1. Low cost
2. Easy operation
3. Light weight and small size
4. No maintenance problem
5. Completely silent operation
6. Gives supply for two hours.

4.4.APPLICATIONS

Suitable for

1. Tube lights
2. Fans
3. Stereo casette recorders
4. Bulbs
5. Soldering irons etc.

Ideal for installation in

1. Offices
2. Clinics
3. Homes
4. Show rooms
5. Banks etc.

If the power rating increased then,

1. Computers
2. CNC machines
3. Telecommunication equipments
4. Microwave networks
5. Police communication networks
6. Operation theatres in hospitals
7. Intensive care units in hospitals etc.

The process flow chart is shown in fig. 4

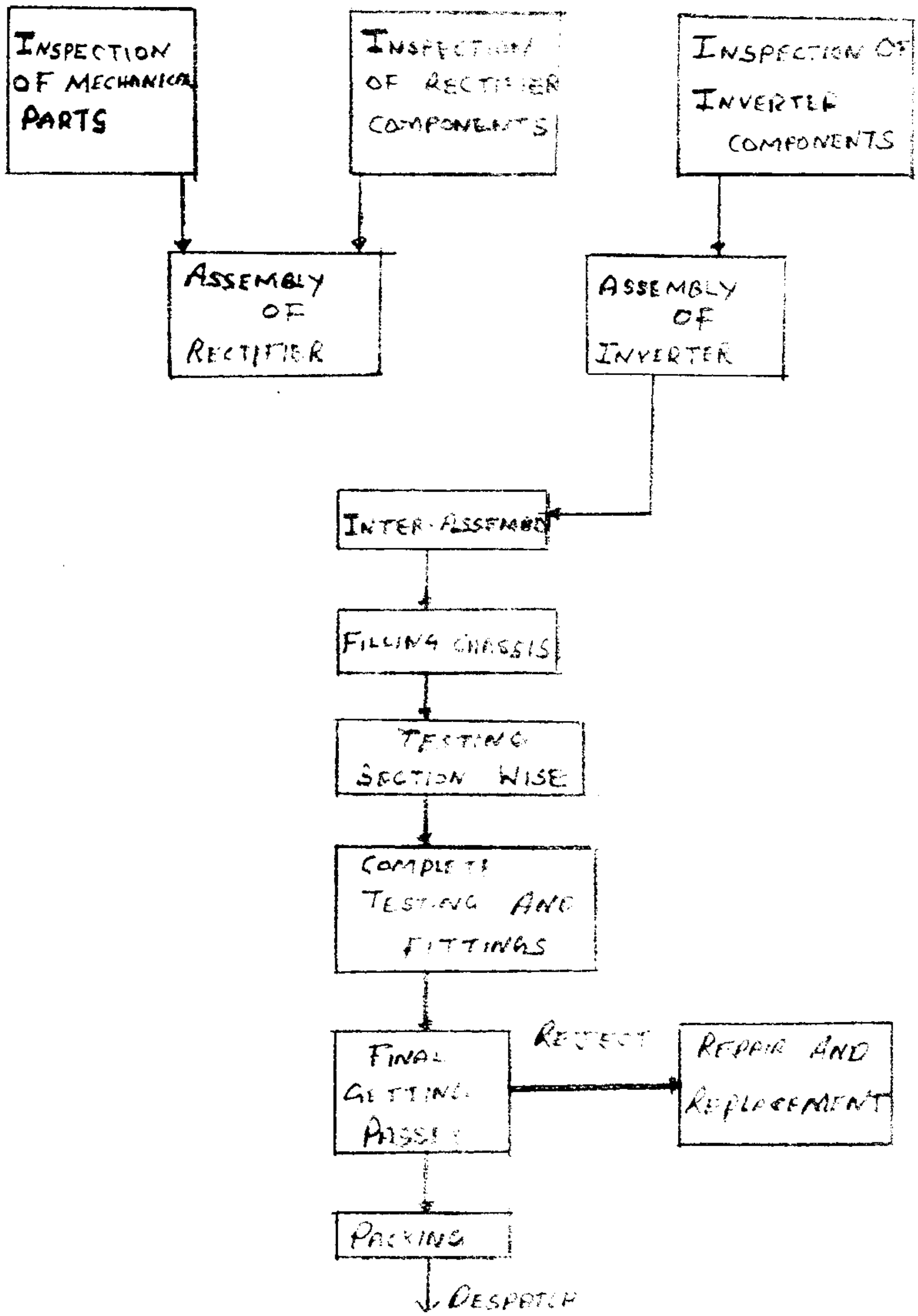


FIG 4.1 → PROCESS FLOWCHART

CHAPTER - V

A UPS is generally bundled along with the computer sold to the user. It is rare to come across a customer who is curious about the make of the UPS. After all it is only an accessory. The attitude of the user is that the dealer knows what is best for the system and he is the best judge. Moreover the customer has no way of testing the equipment he is buying and making sure it lives upto the claims of the seller. The ISI has also set no specifications for the UPS manufactures.

Keeping these problems in mind, we present some hints to the user so that he can choose a UPS with ease and is not easily fooled by the technical jargon used by the dealer.

In case of an off-line UPS, there a time lag when the UPS switches from the mains power to the inverter. This time lag, known as the transfer time, should not be more than 20 milli seconds.

The output waveform of a UPS should prefarably be a pure sine wave, though a quasi-square sine wave will also do. Pure square wave is not recommended for computers.

Five minutes of power for each system is enough to save, quip and shut down the system, if that is what you require. The higher capacity UPS is suitable for organisations where come what may the work must go on. For an installation of two PC ATs, which consume an average of 100 watts each, a 12 volts lead-acid battery is required to supply some 15 amperes.

Before choosing a UPS, the capacity requirement should be determined. For example, one AT printer can make do with a UPS of 500vA. Larger installations need more power.

The capacity of the battery backup is determined by the length of time the computer is run. Maintenance free batteries are very useful but as their capacities increase their prices also rise.

If there is a lot of disturbance in the mains, then a UPS with a high spike and surge suppression should be chosen. A 100dB noise suppression would mean that the output noise is 100 decibels lower than the input noise.

The voltage tolerance is another feature to be checked with care. If the input mains have a consistent low voltage, then a UPS with an input voltage ranging below 190V to a little above 220V would be suitable.

CHAPTER - VI

CONCLUSION

The static UPS system has become very popular since it has no moving parts. The uninterrupted power supply system constructed in this project has been successfully completed and tested. It supplies power in the absence of power from mains automatially.

The cost of the UPS project alone is about Rs.2,500/- (excluding Battery). The cost of the UPS compared to those in market is less.

Power MOSFETs are a relatively recent development. Now becoming increasingly popular with UPS manufacturers, MOSFETs were slow to gain acceptance due to their relatively high cost and also because they had to displace BJTs which were well entrenched. MOSFETs offer several significant advantages over thyristors which include,

1) the ability to operate at frequencies above the audiable range.
2) Low output distortion
3) High overload capacity
4) negligible switching and snubber circuit losses
5) fast response and simple drive circuitry.

CHAPTER - VII

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APPENDIX 1

8.1.PIN DETAILS OF TRANSISTORS

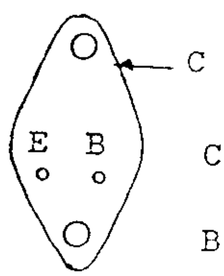
PIN DETAILS AND IMPORTANT RATINGS OF POWER TRANSISTOR 2N3055.

VBE		1.8V	IC	=	4A	VCE	=	4V
hFE		20	IC	=	4A	VCE	=	4V
Fr	=	0.8MHz	IC	=	1A	VCE	=	4V
Fhfe		15KHz	IC	=	1A	VCE	=	4V

RATINGS

IC	=	15A
VCCr	=	70V
Ptotal	=	115W
Tj	=	200C

PIN DETAILS OF TRANSISTOR "2N 3055"



C - COLLECTOR

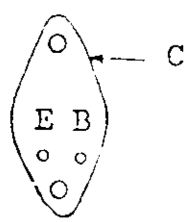
B - BASE

E - EMITTER

PIN DETAILS OF TRANSISTOR "2N3054"

RATINGS

Ration G S	2N3054
VCBO (V)	90V
VCCO (V)	35V
VEBO (V)	7.0V
I.C (A)	4.0V
I.B (A)	2.0V
PT (25 C case (W)	0.25W
Thermal RCS (C/W)	7.0W
Max O/P temp (C)	200 C
Storage temperature	65 C to +200 c



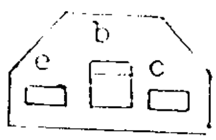
C - COLLECTOR

B - BASE

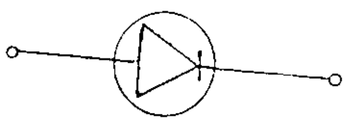
E - EMITER

BC147 TRANSISTOR (NPN)

VCBO	50V max
VCEO	45V max
icem	200mA max
PTOR (TAMB = 25 C)	250 C mv/max
hfe	125 to 500
ICBO (VCB = 20V)	5A
IE = 0; Tj = 125 C	300 MHz typ
@fT	2 dB typ
Tj	125 C max



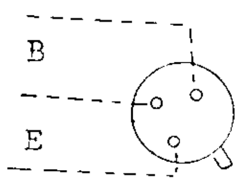
PIN DETAILS OF DIODE IN4001



A - ANNODE

C - CATHODE

SL100 TRANSISTOR nPN



E - EMITTER
B - BASE
C - COLLECTOR

APPENDIX II

8.2 COMPARISON OF CVT AND UPS

A CVT (constant voltage transformer) accepts fluctuating mains as input and generates a fairly smooth output. It buffers the unpredictable mains supply by inductively suppressing the spikes and surges. A CVT has an isolation transformers and a capacitor but nc separate regulatory circuit, and cannot fully regulate wildly fluctuating AC mains.

Surges and spikes cannot get through the high inductance core of the CVT which has a considerable reluctance to changes. The CVT is more efficient at that frequency when the secondary winding and the capacitor form a tuned circuit resonant at 50Hz. The output form a CVT is electrically isolated from the mains, minimising electric shock and interference.

very critical and occasional data loss does not hamper work, a CVT could be the right choice. It does not cost much and will easily sereve the purpose. On the other hand, a UPS could be used where data is very critical and any data loss could prove very expensive. A UPS provides clean power and prevents data loss due to power failure. In terms of absolute power protection, there is nothing to beat the online UPS. But an on-line UPS is very expensive and sometimes costs more than a PC. A well designed off-line UPS having a transfer time which is less than 25 to 30 milli seconds is a cost effective alternative.